

## CUSHION STRUCTURE MANUFACTURING METHOD AND APPARATUS OF THE SAME

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a cushion structure used as a seat cushion or backrest of various seats and to a manufacturing method and apparatus of the cushion structure.

### 2. Description of the Prior Art

Disclosed in Japanese Patent Laid-open Publication No. 11-290153 is a cushion structure the surface of which is formed with a square net rolled up on a metallic square frame at each side end portion thereof and stretched on the frame by adhered thereto. The cushion structure is superior in elastic cushion property in a simple construction since the resiliency of the stretched net is useful to enhance the cushion property of the structure without causing a hardness feeling and a bottomed feeling. Accordingly, the cushion structure can be used as a seat cushion or backrest of various seats. However, the cushion property of the structure is influenced in dependence upon only the resiliency of the stretched net.

During the manufacturing process of the cushion structure, a square die formed with a square groove corresponding with the configuration of the frame is used for setting thereon the square net in place. In a condition where the square net was set on the die, the square frame is coupled with the corresponding square groove of the die so that the square net is rolled up on the square frame at each side end portion thereof and adhered to the square frame in place by thermoplastic resin in a melted condition. When the square frame is coupled with the corresponding square groove of the die, the whole portion of the square net except for each side end portion is brought into contact with the surface of the die surrounded by the square groove and restricted in a stretched condition. With such a setting method, it is difficult to uniformly adjust the tension of the square net in a desired value.

## SUMMARY OF THE INVENTION

It is, therefore, a primary object of the present invention to provide a cushion structure in which a square frame of combined structure composed an elastic frame body and a hard frame body embedded in the elastic frame body is used to enhance the cushion property of the structure by combination of the resiliency of the stretched net and the resiliency of the elastic frame body.

A secondary object of the present invention is to provide a method and apparatus suitable for manufacturing the cushion structure in a simple manner.

According to the present invention, the object is accomplished by providing a cushion structure used as a seat cushion or backrest of a seat, comprising a square net stretched on a square frame of combined structure composed of an elastic square frame body and a hard square frame body embedded in the elastic square frame body, wherein each side end portion of the square net is rolled up on the elastic square frame body of the square frame and fastened to the hard frame body of the square frame. In the cushion structure, it is preferable that a mounting plate adhered to each side end portion of the square net is fastened to the hard square frame body.

According to an aspect of the present invention, there is provided a manufacturing method of a cushion structure the surface of which is formed with a square net rolled up on a square frame at each side end portion thereof and stretched on the square frame by fastened thereto, wherein the manufacturing method comprises the steps of retaining a square net on a support bed in a flat condition, placing a square frame combined structure in position on the square net retained on the support bed, the square frame being composed of an elastic square frame body and a hard square frame body embedded in the elastic square frame body, pressing the square frame of combined structure toward the square net to roll up each side end portion of the square net on each frame portion of the elastic square frame body of the square frame, and fastening each side end portion of the square net to the hard square frame body of the square frame.

According to another aspect of the present invention, there is provided a manufacturing apparatus of a cushion structure the surface of which is formed with a square net rolled up on a square frame at each side end portion thereof and stretched on the square frame by fastened thereto, wherein the manufacturing apparatus comprises a square support bed for retaining a square net thereon in a flat condition, a plurality of clamping mechanisms mounted on the support bed for clamping each side end portion of the square net retained on the support bed, and a plurality of pressure mechanisms mounted on the support bed for pressing a square frame placed on the square net clamped by the clamping mechanisms so that each side end portion of the square net is rolled up on each frame portion of the square frame.

Other object, features and advantages of the present invention will be more readily appreciated from the following detailed description of a preferred embodiment thereof when taken together with the accompanying drawings, in which:

Fig. 1 is a partly broken perspective view illustrating a bottom of a cushion structure in accordance with the present invention;

Fig. 2 is a plan view illustrating the bottom of the cushion structure shown in Fig. 1;

Fig. 3 is a partly broken perspective view of a hard frame body used for the cushion structure shown in Fig. 1;

Fig. 4 is a perspective view of a square net used for the cushion structure shown in Fig. 1;

Fig. 5 is a plan view of a manufacturing apparatus of the cushion structure shown in Fig. 1;

Fig. 6 is a sectional view taken along line 6 - 6 in Fig. 5;

Fig. 7 is a side view of a clamping mechanism in an inoperative condition shown in Fig. 5;

Fig. 8 is a side view of the clamping mechanism in an operated condition;

Fig. 9 is a plan view of the clamping mechanism in an operated condition;

Fig. 10 is a schematic illustration of the manufacturing apparatus in a condition immediately before used for manufacturing the cushion structure shown in Fig. 1;

Fig. 11 is a schematic illustration of an operated condition of the manufacturing apparatus at a first step for manufacturing the cushion structure;

Fig. 12 is a schematic illustration of an operated condition of the manufacturing apparatus at a second step for manufacturing the cushion structure;

Fig. 13 is a schematic illustration of an operated condition of the manufacturing apparatus at a third step for manufacturing the cushion structure; and

Fig. 14 is a schematic illustration of an operated condition of the manufacturing apparatus at a fourth step for manufacturing the cushion structure.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

Illustrated in Figs. 1 and 2 of the drawings is a preferred embodiment of a cushion structure 10 in accordance with the present invention. Fig. 1 is a partly broken perspective view illustrating a bottom of the cushion structure 10, and Fig. 2 is a plan view illustrating the bottom of the cushion structure 10. In this embodiment, a

square frame 10a of combined structure composed of an elastic square frame body 11 made of sponge and a hard square frame body 12 of metal embedded in the elastic square frame 11 is used for the cushion structure 10. To provide the cushion structure 10, a square net 13 made of ultra-strong polyester threads woven in meshes is stretched on the square frame 10a.

As shown in Figs. 1 and 2, the elastic frame body 11 is formed in a circular cross-section in a condition where it has been assembled in the cushion structure 10. Before assembled in the cushion structure 10, the elastic frame body 11 is formed semi-oval in cross-section as shown in Fig. 12. As shown in Figs. 1 and 3, the hard square frame body 12 is in the form of a square frame of L-letter shape in cross-section and is integrally embedded in the elastic square frame 11 and exposed in a condition where a flat portion 12b of the frame is maintained in contact with a flat portion of the elastic square frame 11.

As shown in Figs. 1, 2 and 4, a mounting plate 14 is adhered to each side end portion of the square net 13 by means of an adhesive agent of thermoplastic resin. For adhesion of the mounting plate 14, an amount of polyester synthetic resin powder is heated at about 260 °C and brought into contact with the mounting plate 14. In a condition where the resin powder is maintained in a melted condition, the mounting plate 14 is placed on each side end portion of the square net 13, and the melted resin powder is hardened by cooling under pressure. Thus, the mounting plate 14 is firmly adhered to each end portion of the square net 13.

In the cushion structure 10, the square net 13 is rolled up at each side end portion thereof on each frame portion 11a of the elastic frame body 11, and the mounting plate 14 is fixed to the flat portion 12b of hard frame body 12 by means of bolts 15 in a condition where the square net 13 is maintained in its rolled up position. In such a condition, each frame portion 11a of the elastic frame body 11 is compressed by each side end portion of square net 13 and formed in a circular cross-section. Thus, the net 13 is uniformly stretched on the square frame 10a of combined structure composed of the elastic frame body 11 and hard frame body 12 and retained in place with a desired tension.

In the cushion structure 10, the net 13 is placed at the upper surface of the square frame 10a of combined structure in a condition where each side end portion of

the net 13 is rolled up on each frame portion 11a of the elastic frame body 11 and fixed to the flat portion 12b of hard frame body 12 at the bottom surface of the square frame 10a. With such a construction, the resiliency of elastic frame body 11 is added to the resiliency of net 13 to enhance the cushion property of the structure 10. As in the cushion structure 10, each side end portion of square net 13 is fixed to the flat portion 12b of hard frame body 12 through each frame portion 11a of elastic frame body 11, the elastic frame body 11 is useful to eliminate a difference in tension of the net 13 and to retain the entirety of net 13 in a uniformly stretched condition. This is useful to provide the cushion structure 10 without causing any local difference in cushion property. The cushion structure 10 with such property can be adapted as a seat cushion or backrest of various seats or as a cushion frame of the seat cushion or backrest.

The cushion structure 10 can be manufactured by manufacturing steps shown in Figs. 11 to 14 in use of a manufacturing apparatus 20 shown in Figs. 5, 6 and 10. As shown in Fig. 5, the manufacturing apparatus 20 is composed of an outer support bed 21 in the form of a square frame, an inner support bed 22 in the form of a square frame disposed in the support bed 21, a plurality of clamping mechanisms 23, and a plurality of pressure mechanisms 24. The clamping mechanisms 23 are arranged in a pair and opposed to each other respectively at the left and right sides of support bed 21 and at the front side and backside of outer support bed 21. The pressure mechanisms 24 are arranged at each corner of the support bed 21 and opposed to one another.

As shown in Figs. 6 to 9, the clamping mechanisms 23 each are composed of a support bracket 23a, a clamping lever 23b, an operation lever 23c and a connecting arm 23d. The clamping lever 23b is pivotally mounted at its rear end portion on a front portion of support bracket 23a for rotary movement in a vertical direction. The operation lever 23c is pivotally connected at its front end to the rear end portion of clamping lever 23b for rotary movement in a vertical direction. The connecting arm 23d is pivotally mounted at its rear end on a rear end portion of support bracket 23a for rotary movement in a vertical direction and pivotally connected at its front end to an intermediate portion of operation lever 23c for rotary movement in a vertical direction. The support bracket 23a is mounted on the support bed 21 to place the clamping mechanism 23 in position. When the clamping mechanism 23 is in an inoperative condition, the operation lever 23c is retained in an upward position as shown in Fig. 7 to retain the clamping lever 23b in an upward position. When the operation lever 23c

is moved downward to rotate in a clockwise direction, the clamping lever 23b is rotated in a counterclockwise direction and retained in a horizontal condition to be pressed on the inner support bed 22 as shown in Fig. 8.

As shown in Fig. 6, the pressure mechanisms 24 each are substantially the same in construction as the clamping mechanism 23. Namely, the pressure mechanisms 24 each are composed of a support bracket 24a, a pressure lever 24b, an operation lever 24c and a connecting arm 24d. When the operation lever 24c is moved downward, the pressure lever 24b is rotated in a clockwise direction and retained in a horizontal condition to be pressed inside the inner support bed 22.

Illustrated in Figs. 11 to 14 is a manufacturing process of the cushion structure 10. In Fig. 10, there is illustrated an inoperative condition of the manufacturing apparatus 20. The manufacturing process of the cushion structure 10 is carried out by the steps of retaining the square net 13 on the inner support bed 22 in a flat condition as shown in Fig. 11, putting the square frame 10a of combined structure on the square net 13 supported on the inner support bed 22 as shown in Fig. 12, pressing the square frame 10a of combined structure to roll up each side end portion of the square net 13 on each frame portion 11a of the elastic frame body 11 as shown in Fig. 13, and fastening each side end portion of the rolled up square net 13 to the flat portion 12b of the hard square frame body 12 as shown in Fig. 14.

In use of the manufacturing apparatus 20, a rubber plate 23e for prevention of slippage is attached to each distal end of the clamping lever 23b as shown in Fig. 6, and the manufacturing apparatus 20 is set in an inoperative condition as shown in Fig. 10. At the first step of the manufacturing process shown in Fig. 11, the square net 13 is placed on the inner support bed 22, and each operation lever 23c of the clamping mechanisms 23 is operated to bring the rubber plate 23e attached to the clamping lever 23b into contact with each mounting plate 14 on the square net 13. Thus, the square net 13 is clamped by the clamping lever 23b at eight portions thereof on the inner support bed 22 and retained on the support bed 22 in a flat condition as shown in Fig. 11.

At the second step of the manufacturing process shown in Fig. 12, the square frame composed of the elastic frame body 11 and hard frame body 12 is placed in position on the square net 13 horizontally supported on the inner support bed 22. At

the third step of the manufacturing process shown in Fig. 13, the operation levers 24b of pressure mechanisms 24 are operated to bring the pressure levers 24b into contact with the flat portion 12b of the hard frame body 12 and to press the square frame 10a downward against the square net 13. Thus, each frame portion 11a of the square frame 11 is compressed into circular in cross-section, and the square net 13 is rolled up at each side end portion thereof on the square frame 11 and stretched with a predetermined tension. In such operation of the pressure mechanisms 24, it is desirable to mutually operate the pressure mechanisms 24 opposed to each other.

At the fourth step of the manufacturing process shown in Fig. 14, the operation levers 23b of clamping mechanisms 23 are successively released from the stretched net 13, and the mounting plate 14 is placed in position on the flat portion 12b of hard frame body 12 at the released portion of the stretched net 13 and fixed to the hard frame body 12 by bolts 15. In this instance, it is desirable to release the clamping mechanisms 23 opposed to each other thereby to successively fasten the mounting plate 14 to the hard frame body 12 at the released end portion of the stretched net 13.

With the manufacturing process described above, the cushion structure 10 is manufactured with the net 13 stretched with a predetermined tension on the elastic frame body 11. In the cushion structure, the resiliency of elastic frame body 11 is added to the resiliency of net 13 to enhance the cushion property of the cushion structure 10 superior in elasticity without causing any local difference in the cushion property.

During the manufacturing process, the square net 13 retained in place on the support bed 22 is stretched by the square frame 10a pressed thereon and rolled up at each side end portion thereof on the elastic frame body 11. Subsequently, the mounting plate 14 is fastened to each frame portion of the hard frame body 12 to retain the net 13 in the stretched condition. Thus, the tension of the net 13 can be adjusted by the pressure force applied to the square frame 10a.